



DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

SPECIFICATION

L-BAND MICROWAVE BANDPASS FILTER KIT

1. SCOPE

1.1 Scope.- The filter kit described herein is for an L-band microwave filter to work in conjunction with FAA Long Range Radar Systems. The radar systems operate in the frequency band between 1250 MHz and 1350 MHz. The L-band microwave filter will replace a section of waveguide presently installed between the waveguide switch and the point where the waveguide enters the building. A standard waveguide section will be required in addition to the filter to maintain an exact overall total length specified herein. A two way broadband directional coupler will be provided at the output of the filter to allow measurement of actual in-band transmitted power on the ARSR.

2. APPLICABLE DOCUMENTS

2.1 General.- The following specifications, standards, or other documentation form a part of this specification and are applicable in their entirety unless otherwise specified herein. The applicable issues of these specifications are listed in the invitation for bids or the request for proposals.

2.1.1 FAA specifications.-

FAA-G-2100 Supplement 4, Electronic Equipment, General
Requirements, FAA List of Applicable Documents,
July 10, 1970

FAA-G-2100/1 Electronic Equipment, General Requirements - Part 1,
Basic Requirements for all Equipments, July 10, 1970

FAA-G-2100/1 Amendment 2, June 28, 1973

2.1.2 FAA standards.-

FAA-STD-001 Color and Texture of Finishes for National Airspace
System Equipment, December 11, 1969

FAA-STD-002 Federal Aviation Standard for Engineering Drawings,
July 21, 1966

FAA-STD-002 Amendment 1, October 6, 1967

FAA-STD-012 Paint Systems for Equipment, June 16, 1969

FAA-STD-013 Quality Control Program Requirements, March 4,
1970, and Amendment 4, April 9, 1970

2.1.3 FAA drawing.-

B-21216 Standard Nameplate

2.1.4 Military specifications.-

MIL-I-45208A Inspection System Requirements

MIL-E-17555 Electronic and Electrical Equipment and
Associated Repair Parts, Preparation for
Delivery of

MIL-D-1000 Drawings, Engineering and Associated List

2.1.5 Military standards.-

MIL-STD-202 Test Methods for Electronic and Electrical
Component Parts

(Copies of this specification and other FAA specifications, standards, and drawings may be obtained from the Contracting Officer in the Federal Aviation Administration office issuing the invitation for bids or request for proposals. Request should fully identify material desired, i.e., specification, standard, amendment, and drawing numbers and dates. Request should cite the invitation for bids, request for proposals, or the contract involved, or other use to be made of the requested material.)

(Single copies of military specifications and standards may be requested by mail or telephone from the U.S. Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, PA. 19120; for telephone requests, call 215-697-3321, 8 a.m. to 4:30 p.m., Monday through Friday. Not more than five items may be ordered on a single request. The applicable invitation for bid or contract number shall be cited.)

3. REQUIREMENTS

3.1 Equipment to be furnished by the contractor.- The contractor shall furnish the quantity of L-Band Microwave Bandpass Filter Kits specified in the contract. The waveguide filter, filler section, bi-directional coupler, bends, hangers, and pressure windows required for a complete and permanent installation of the L-band filter shall be provided by the contractor. Each filter kit shall be complete with ancillary items specified herein. Any feature or item necessary for proper operation in accordance with the requirements of this specification shall be incorporated even though that feature or item may not be specifically described herein. Installation of the filter will be performed by others and is not included as part of this specification.

3.2 Ambient conditions.- Except where otherwise stated, all specification requirements shall be met under the following ambient conditions:

Ambient temperature	
Operating	-10°C to +50°C
Nonoperating	-60°C to +50°C
Ambient relative humidity	5% to 90%, including condensation due to temperature changes
Salt atmosphere	As encountered in coastal regions
Duty	Continuous and unattended

3.3 Normal operating conditions.- Except where otherwise stated, all specification requirements shall be met under the following normal operating conditions.

Peak power	5 megawatts
Pulse repetition frequency	Mean - 360 pps or three (3) period staggered (ratio or 13:14:15 averaging 360 pps). Optional pulse intervals of 2700, 2780, 2820, and 2860 usec.
Pulsewidth	2 usec nominal

Duty Cycle	0.00071 nominal
Pressurization	3 to 5 psi (gauge pressure) dry air

3.4 Storage temperature.- The quality of materials, components and fabrication techniques used in the manufacture of the filter and ancillary items specified herein shall be such that performance requirements shall be met in the event such equipment be in storage for a period of three (3) years in an ambient temperature range from -60°C to 50°C.

3.5 Electrical requirements.- The design and performance of the L-band filter assembly shall be fabricated in accordance with specifications FAA-G-2100/1b and FAA-G-2100, Supplement 4. The requirements of the bi-directional coupler are included in paragraph 3.8.

3.5.1 Power handling capability.- The L-band filter and filler section when connected as an assembly shall be capable of handling continuously no less than 6 megawatts at a duty cycle of 0.001 with pulsewidth and pulse repetition frequencies as previously described under paragraph 3.3.

3.5.2 Frequency.- Components shall be capable of meeting all requirements stated herein when operating anywhere in the frequency band of 1250 to 1350 MHz.

3.5.3 VSWR.- The VSWR of the L-band filter and the filler section when connected as an assembly shall not exceed 1.3:1 for all frequencies from 1250 MHz to 1350 MHz.

3.5.4 Insertion loss.- The insertion loss shall not exceed 0.3 dB over the frequency range of 1250 MHz to 1350 MHz.

3.5.5 Attenuation characteristics.- The L-band filter shall be a fixed-tuned multiple stage direct coupled bandpass filter. The filter shall be designed to have attenuation characteristics and bandpass response as follows:

<u>Frequency</u>	<u>Attenuation</u>
1180 MHz	70 dB minimum
1200 MHz	60 dB minimum
1210 MHz	50 dB minimum
1230 MHz	15 dB minimum
1250 MHz to 1350 MHz	0.3 dB maximum
1380 MHz	15 dB minimum
1400 MHz	35 dB minimum
1430 MHz	50 dB minimum
1450 MHz	60 dB minimum
1480 MHz	60 dB minimum
1550 MHz to 1700 MHz	70 dB minimum
1800 MHz	60 dB minimum

3.5.6 L-band filter (100 dB option).- An L-band microwave filter capable of attenuating spurious radiation of at least 100 dB at 1480 MHz shall be provided. This filter may be a combination of the L-band filter previously described herein and an extra section of waveguide with the additional filter stages required to obtain the bandpass specified in 3.5.6.1 herein. The requirements of this filter are identical to those stated herein and are applicable unless specifically stated otherwise in the following subparagraphs.

3.5.6.1 Attenuation characteristics.- In lieu of the bandpass response contained in paragraph 3.5.5, the following shall apply:

<u>Frequency</u>	<u>Attenuation</u>
1180 MHz	70 dB minimum
1200 MHz	60 dB minimum
1210 MHz	50 dB minimum
1230 MHz	15 dB minimum
1250 to 1350 MHz	0.3 dB maximum
1380 MHz	15 dB minimum
1400 MHz	35 dB minimum
1430 MHz	50 dB minimum
1450 MHz	60 dB minimum
1480 MHz	100 dB minimum
1500 MHz	100 dB minimum
1550 MHz to 1700 MHz	70 dB minimum
1800 MHz	60 dB minimum

3.6 Mechanical requirements.-

3.6.1 Pressurization capability.- The radar utilizes dry air waveguide pressurization in the range from 3 to 5 PSI (gauge pressure) to keep the internal waveguide humidity low. The L-band filter section shall be constructed of thick wall waveguide material that will withstand pressurization of up to 25 PSI (gauge pressure) with no changes in electrical performance characteristics due to structural deformation. The leak rate of the L-band filter and filler section when connected as an assembly and pressurized at 25 PSI (gauge pressure) shall not exceed 1.0 cubic inch per minute. The leak rate at 3 PSI (gauge pressure) shall preclude a pressure decrease of not more than .5 PSI (gauge pressure) during a one-week period. In the event the L-band filter requires pressurization exceeding 3 PSI (gauge pressure) to meet the performance requirements specified herein, the contractor will furnish waveguide windows to isolate the L-band filter pressurization from the existing waveguide pressurization. All gaskets, regulators, gauges, hoses, and all other ancillary items required for proper electrical and mechanical operation in the existing waveguide and pressurization environment shall be furnished. The design of the filter shall be such that no more than 25 PSI (gauge pressure) off-dry air shall be required.

3.6.2 Physical dimensions.- The L-band filter shall be 96.00 inches ± 0.25 inches long. The dimensions of all rectangular waveguide components, flanges, etc., shall be compatible with WR-650 inside dimensions and UG-418A/U flanges.

3.6.3 RF connections.- The RF input and output to the L-band filter and filler waveguide section shall be standard type flanged waveguide connections that shall mate with the waveguide sections previously described herein. The L-band filter and filler shall be fitted with flanges that mate with UG-418A/U flanges. The contractor shall furnish gaskets and flange accessories to insure pressurization of the system. No support of the filter other than the two flange connections shall be required.

3.6.4 RF component finish.- The inside surfaces and joints of brass RF waveguide components shall be suitably protected against tarnishing and deterioration. The interior coating shall be such as to not result in an increase in attenuation to protect against corrosion. All components shall have an outside protective coating to increase their resistance to corrosion.

3.6.5 Finish.- The filter shall be finished in accordance with paragraph 1-3.8, FAA-G-2100/1, FAA-STD-001, and FAA-STD-012, as applicable.

3.6.5.1 Part marking.- The part shall be marked in accordance with paragraph 1-3.12, FAA-G-2100/1.

3.6.5.2 Permanency.- The marking shall remain legible and shall not be discolored when tested in accordance with MIL-STD-202, Method 215, Resistance to Solvents.

3.7 Instruction books.- Commercial instruction books shall be furnished in accordance with the contract schedule and shall include the following data as a minimum:

- Contractor's name and address
- Contract number
- Contract date
- Contract guarantee
- Manufacturer's type and model
- General description
- Theory of operation
- Installation data
- Operational characteristics
- Maintenance data
- Illustrated parts breakdown
- Replaceable parts list

3.7.1 Drawings.- Outline drawings of the L-band filter and filler shall be provided with each kit. Drawings are to be standard FAA "D" size with FAA title block in accordance with FAA-STD-002.

3.8 Bi-directional coupler.- A bi-directional coupler shall be provided for mounting on the output end of the L-band filter assembly. The calibrated coupling loss in dB over the complete frequency band shall be permanently tabulated or shown graphically on the coupler. The bi-directional coupler shall have a directivity of 20 dB minimum and a maximum VSWR of 1.1 over the frequency range of 1250 to 1350 MHz. The insertion loss shall be 0.25 dB or less. Two coupling ports shall be provided for use in measurement of forward and reverse power measurement of the ARSR radar. Each port shall have a coupling of 40.0 ± 1.0 dB and maximum VSWR of 1.25 over the frequency band of 1250 to 1350 MHz. Type "N" coaxial jacks be provided. The power handling requirement of paragraph 3.5.1 and pressurization capability of paragraph 3.6.1 are applicable. The coupler shall be fitted with flanges that mate with UG-418A/U flanges and shall include required gasket and flange accessories.

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- The contractor shall provide the test facilities, instrumentation and services which are acceptable to the Government, that are required to perform the tests specified herein. Records of tests including examinations and inspections, shall be kept complete and available to the Government as required by the contract. The Government reserves the right to witness or perform any of the tests set forth in this specification when such tests are deemed necessary by the Government to assure that the equipment conforms to the prescribed requirements. The tests shall be conducted by the contractor to demonstrate compliance with this specification. The contractor shall furnish test plans and procedures which shall detail the time, place, and manner in which the equipment shall be tested. These tests, as a minimum, shall consist of the following:

<u>Test</u>	<u>Reference Paragraph</u>
(a) Quality Control (Inspection)	4.3.1
(b) Preliminary tests	4.3.2
(c) Design qualification tests	4.3.3
(d) Type tests	4.3.5
(e) Production tests	4.3.6

Tests specified in (a) and (e) above, shall be conducted on each equipment procured under this specification. Tests specified in (b) and (c) shall be conducted on the first equipment. Test (d) shall be performed as required in FAA-G-2100/1 and the number of applicable equipments will be dependent on the quantity specified in the contract schedule. Modifications to equipment generated as a result of any tests shall be incorporated into each equipment delivered at no additional cost to the Government.

4.1.1 Procedures.- Submission and approval of test procedures shall be as specified in FAA-STD-013. When approved, the test procedures shall apply whenever tests are specified herein.

4.1.1.1 Inspection system requirements.- Contractor's inspection system shall be in accordance with MIL-I-45208A.

4.1.1.2 Calibration system requirements.- Calibration requirements shall be in accordance with MIL-C-45662A.

4.2 Test Conditions.-

4.2.1 Environment.- Unless otherwise specified, tests shall be conducted at an ambient temperature of $25^{\circ}\text{C} \pm 10^{\circ}$.

4.3 Factory tests and inspections.- The contractor shall conduct factory tests to demonstrate complete compliance with this specification.

4.3.1 Quality control.- The contractor shall provide and maintain a quality control program in accordance with FAA-STD-013. The plan shall be submitted for Government approval within 45 days after award of contract. All tests and inspections made by the contractor shall be subjected to Government inspection. The term "Government inspection", as used in this specification, is defined as an FAA representative witnessing the contractor's testing and inspection, and carrying out such visual and other inspection as deemed necessary to assure compliance with the contract requirements.

4.3.1.1 Inspection.- The contractor's inspection system shall assure conformance to paragraph 3.6 of this specification and applicable sections of Specification FAA-G-2100/1.

Inspection shall include general mechanical tests and visual inspections as necessary to determine that the L-band filter including the bi-directional coupler is fabricated and finished in a workmanlike manner and meets specified physical requirements.

JAN/MIL components will be handled as specified in paragraph 1-4.5 of FAA-G-2100/1 as applicable including invoices certifying his product.

Acceptance of the parts and materials will not constitute final acceptance or approval of their specific uses in the L-band filter set and including the bi-directional coupler.

4.3.2 Preliminary tests.- Contractor's preliminary tests specified in paragraph 1-4.3.1, FAA-G-2100/1 shall be performed on the first production equipment.

4.3.3 Design qualification tests.- In addition to the tests specified in paragraph 1-4.3.2, FAA-G-2100/1, the design qualification tests shall include tests to validate power handling capability (paragraph 3.5.1), and salt spray (corrosion) test, Method 101D, MIL-STD-202. The salt spray tests shall simulate the effects of salt atmosphere as encountered in coastal regions.

4.3.4 Specific tests.- Tests shall demonstrate compliance with requirements of paragraphs 3.2, 3.5, 3.6 and 3.8 of this specification and shall include as a minimum the following tests:

- (a) Electrical tests - L-Band, filter
 - Passband VSWR (paragraph 3.5.3)
 - Passband Insertion Loss (paragraph 3.5.4)
 - Stopband Attenuation (paragraph 3.5.6.1)
 - *Power handling capability (paragraph 3.5.1)
- (b) Mechanical and visual tests - L-Band, filter
 - Physical dimensions (paragraph 3.6.2)
 - Pressurization capability (25 psig, paragraph 3.6.1)
 - *Salt spray test (Method 101D, MIL-STD-202)
 - Visual tests (Inspect for absence of pits, scratches, burrs, etc., which might cause arcing or other deleterious effects.)
- (c) Electrical tests - Bi-directional Coupler
 - Over the passband 1250 MHz -1350 MHz, the following tests are required:
 - Directivity, 20 dB minimum (paragraph 3.8)
 - VSWR, 1.1:1 maximum (paragraph 3.8)
 - Insertion loss, 0.25 dB maximum (paragraph 3.8)
 - Two coupling ports
 - Attenuation, 40.0 ± 1.0 dB (paragraph 3.8)
 - VSWR, 1.25:1 maximum (paragraph 3.8)
- (d) Mechanical and visual tests - Bi-directional Coupler
 - Physical dimensions (paragraph 3.8)
 - Pressurization capability (25 psig, paragraph 3.8)
 - *Salt spray test (Method 101D, MIL-STD-202)
 - Visual tests (Inspect for absence of pits; scratches, burrs, etc., which might cause arcing or other deleterious effects)

Legend

*These tests to be performed on first production unit only.

4.3.5 Type tests.- Type tests shall be performed on the first production unit and other units selected by the Government in accordance with paragraph 1-4.3.3, FAA-G-2100/1. These tests shall demonstrate compliance with all of the requirements of this specification and shall include all the tests described in paragraph 4.3.4 herein.

4.3.6 Production tests.- Production tests shall be performed on each production equipment in accordance with paragraph 1-4.3.4, FAA-G-2100/1. These tests shall demonstrate compliance under normal test conditions with all of the requirement of this specification and shall include all of the tests described in paragraph 4.3.4 herein.

4.3.7 Data forms.- Two copies of the test procedures and data sheets shall be packed and shipped with the equipment. One copy shall be furnished to the Technical Officer. All data sheets shall include the signatures and titles of persons performing and witnessing the tests, location and date of tests, and the serial number of the L-band filter and bi-directional coupler equipment tested.

5. PREPARATION FOR DELIVERY

5.1 Packing.- The contractor shall be responsible for protecting, preserving, packing, and marking all equipment for delivery. Equipment delivery shall be in accordance with MIL-E-17555, Level B.

6. NOTES

6.1 Notes.- None.

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